

Chlorinated Pesticides and PCBs in Colonial Nesting Water Birds of Galveston Bay, Texas

Ms. Donell S. Frank
Graduate Student
Department of Wildlife and Fisheries Sciences, Texas A&M University
B&B Laboratories, Inc.

Ms. Frank received her BS degree in Secondary Education from University of Oklahoma in 1990. Ms. Frank has over 8 years of experience in environmental analytical chemistry and specializes in the characterization of environmental matrices for chlorinated pesticides and polychlorinated biphenyls using high-resolution gas chromatography with electron capture detection and saturated hydrocarbons using high-resolution gas chromatography with a flame ionization detector. As a former employee of the Geochemical and Environmental Research Group (GERG) at Texas A&M University, Ms. Frank has extensive experience in instrumental application (GC and HPLC) and quality control programs. She was involved in the characterization of chlorinated hydrocarbons, tributyl tins, and organophosphate pesticides for several private and government agencies including US Fish and Wildlife Services, Environmental Protection Agency and National Oceanic and Atmospheric Administration. In addition to her laboratory experience, Ms. Frank also has three years of field experience with the EMAP program participating extensively in sample collection and as a boat captain. At present Ms. Frank works at B&B Laboratories, Inc. in College Station, Texas (ph 409-693-3446) as an Organic Analytical Manager. At B&B Laboratories in addition to her instrumental laboratory duties, Ms. Frank oversees all aspects of sample receiving and preparation for all the environmental programs. She participates in all aspects of method development and validation for trace organic analysis.

Chlorinated Pesticides and PCBs in Colonial Nesting Water Birds of Galveston Bay, Texas

Donell S. Frank

Department of Wildlife and Fisheries Sciences, Texas A&M University,
College Station, Texas

Miguel A. Mora

U.S. Geological Survey, Department of Wildlife and Fisheries Sciences, Texas A&M University,
College Station, Texas

Jose L. Sericano

Geochemical and Environmental Research Group, College Station, Texas

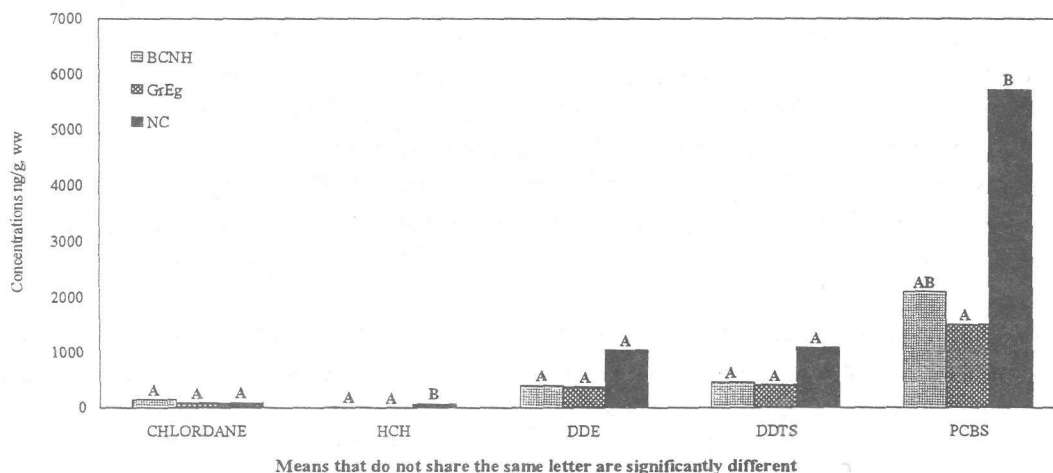
Eggs from neotropic cormorants (NC) (*Phalacrocorax brasilianus*), black-crowned night herons (BCNH) (*Nycticorax nycticorax*) and great egrets (GrEg) (*Ardea alba*) were collected from a heronry located on Alexander Island near the Houston Ship Channel in Galveston Bay. Eggs from neotropic cormorants were also taken from three additional islands located in Galveston Bay and from two locations outside the bay. Individual eggs were analyzed for persistent organochlorine pesticides (i.e. DDTs, chlordanes) and polychlorinated biphenyls (PCBs) to determine the accumulation of these contaminants in the various species and to evaluate potential impacts on reproduction.

Galveston Bay lies southeast of the Houston metropolitan area in the northwest Gulf of Mexico on the coast of Texas and is considered one of the most productive estuaries in the United States. The estuary system of Galveston Bay contains almost 50 percent of the nation's petrochemical production and 30 percent of the petrochemical industry (Gerston 1995). The Houston Ship Channel consists of a dredged deep-draft channel that extends 72 km extending through Galveston Bay to the Gulf of Mexico and is heavily polluted with industrial and agricultural contaminants (King et al. 1986). Galveston Bay has been the recipient of various environmental injuries over the last several years because of accelerated growth in Houston. In addition, the bay receives freshwater inflow from the San Jacinto River and the Trinity River, which originates in Dallas/Ft. Worth. Galveston Bay also receives runoff from an area in excess of 9,300 km², which likely introduces many pesticide pollutants to the bay. These environmental contaminants, such as chlorinated pesticides and PCBs pose a major threat to the health of wildlife nesting and feeding in the Bay.

Four sites were located in Galveston Bay, one site was located in the San Bernard Refuge on the Texas Gulf Coast and another site was located inland, southeast of Dallas, Texas. Samples were collected during May-August 1996. Ten neotropic cormorant eggs, nine black-crowned night heron eggs and seven great egret eggs were collected from Alexander Island, in the Houston Ship Channel. Four eggs from neotropic cormorants were collected in Roll Over Pass Island, four in Smith Point Island and ten in Vingt-et-un Island, all located in Galveston Bay. Seven eggs from neotropic cormorants were also taken from the San Bernard Refuge located outside the bay and eleven eggs were collected at an inland site in Telfair Island.

The geometric mean of total PCB levels in eggs of neotropic cormorants, black-crowned night herons and great egrets from Alexander Island were 5,700, 2,100 and 1,500 ng/g ww, respectively. Predominant PCB congeners in the three species were 153, 138, 180, 118, 99 and 187. These congeners comprised between 53 and 64% of the total PCB load in the samples. The geometric mean of DDE levels were 1,043, 401 and 372 ng/g ww in neotropic cormorants, black-crowned night herons and great egrets, respectively. PCBs for fish-eating birds on Alexander Island were significantly ($P < 0.05$) higher in neotropic cormorants than in great egret eggs, but were similar to black-crowned night heron eggs. However, geometric means for cormorants were 2 times greater than the mean for black-crowned night herons. Hexachlorocyclohexanes (HCHs) were significantly ($P < 0.05$) higher in neotropic cormorant eggs than in black-crowned night heron and great egret eggs, which were at background levels. DDTs, DDE, and chlordane levels were not significantly different among species (Figure 1).

Figure 1. Concentration of Pesticides and PCBs in fish-eating birds nesting on Alexander Island



Mean total PCB concentrations were higher in neotropic cormorant eggs from Alexander Island than in eggs from areas farther away from the Houston Ship Channel, including control areas outside the bay. In contrast, total DDT concentrations were higher in eggs of neotropic cormorants from control locations outside the bay than inside the bay, possibly due to regional sources. Eggs of cormorants nesting on Alexander Island had the highest concentrations of total PCBs and were significantly different from Roll Over Pass Island, San Bernard and Telfair Island, but were similar to Vingt-et-un Island and Smith Point Island. DDE concentrations in eggs of cormorants were somewhat higher at the inland site near Dallas, however they were similar to DDE concentrations in eggs from Alexander Island. DDE concentrations in eggs from Alexander Island were significantly higher than DDE in eggs from cormorants nesting at other sites in Galveston Bay; however, they were similar to eggs of cormorants from San Bernard off Galveston Bay. Chlordane and HCH were higher in eggs of cormorants from Alexander Island however, they were relatively low in all cases (Figures 2 & 3).

Figure 2. Concentrations of PCBs in neotropic cormorants from Galveston Bay and 2 references sites (geometric means ng/g, ww)

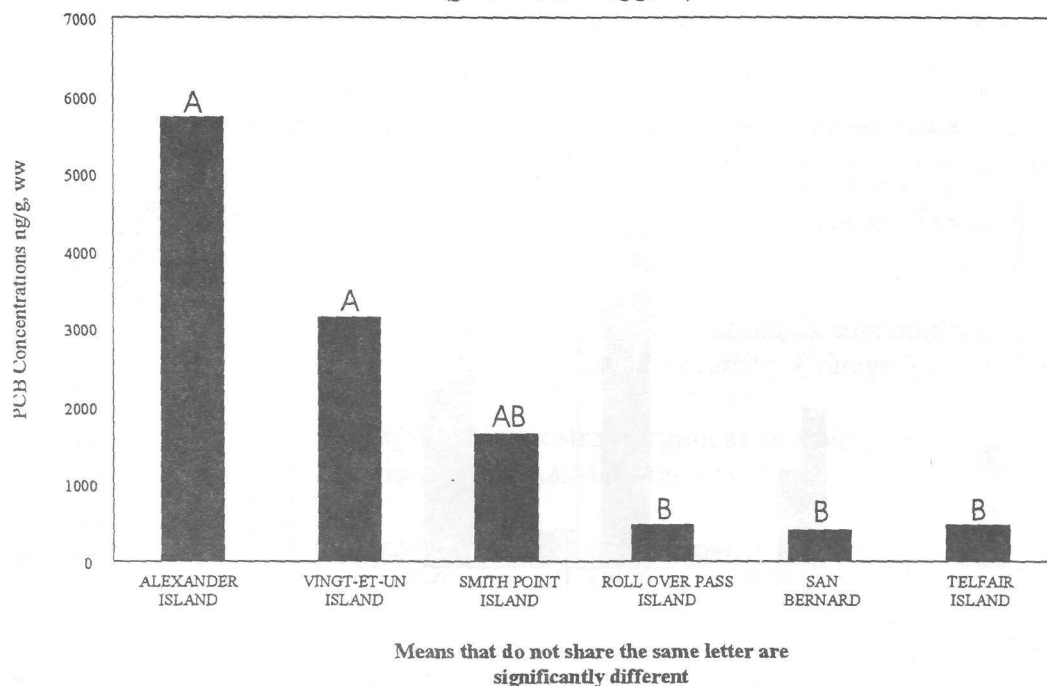
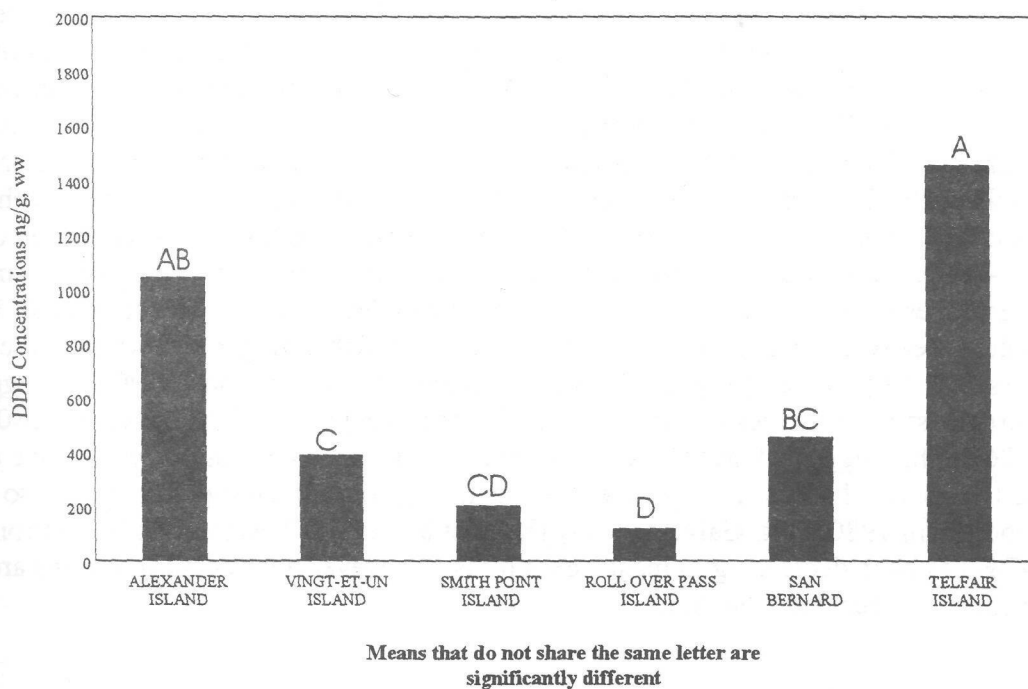
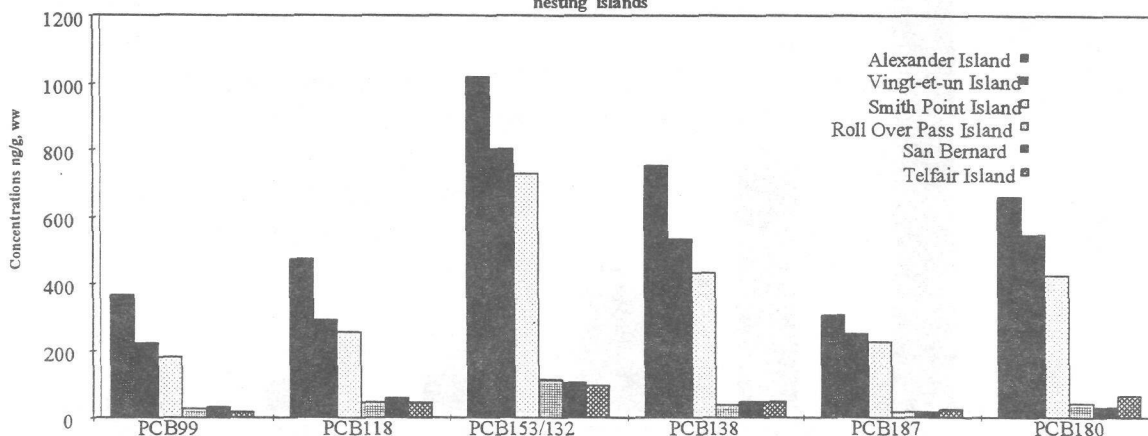


Figure 3. Concentrations of DDE in neotropic cormorants from Galveston Bay and 2 references sites (geometric means ng/g, ww)



Concentrations of the most common congener-specific PCBs showed similar patterns in eggs of cormorants from all colonies. These six congeners contributed 54 to 64 % of total PCBs (Figure 4).

Figure 4. Concentration of the most common congeners in eggs of neotropic cormorants for the different nesting islands



Concentrations of PCBs in eggs of cormorants were significantly higher on Alexander Island than in other sites of Galveston Bay and off Galveston Bay. Alexander Island is closer to the Houston Ship Channel (HSC) and to industrial areas. This suggests that neotropic cormorants and other fish-eating birds nesting in this area feed near the HSC thus are likely to accumulate higher concentrations of contaminants than birds feeding farther from the HSC. Our results agree with previous studies of PCB levels in sediments and invertebrates from Galveston Bay. These studies showed that the HSC was the most contaminated of several sites in Galveston Bay (Gardinali 1996 and Sericano 1993). PCB concentrations were different among eggs of the various species of fish-eating birds nesting on Alexander Island with higher levels in cormorants. This may be due to differences in diet or size of fish ingested. Cormorants usually take larger fishes than egrets and herons and larger fish usually have greater concentrations of contaminants than smaller fish. Concentrations in eggs of cormorants from Alexander Island and other sites in Galveston Bay were near or above levels at which some detrimental effects have been observed in double-crested cormorants in The Great Lakes. PCB levels of 4 ppm in eggs of cormorants in The Great Lakes have been associated with lethality and deformities (Yamashita et al. 1993). Our results agree with many studies of PCB congeners in fish-eating birds, which indicate that congeners 153, 138, 180 and 118 are the most common. Concentrations of PCBs in eggs of fish-eating birds nesting in Galveston Bay were similar to those previously reported in 1980-81 (King et al. 1986). This suggests that PCB sources for birds on Galveston Bay may not have decreased in the last 15 years. Finally, DDE concentrations in eggs of fish-eating birds were also similar to those reported in 1980-81 in Galveston Bay (King et al. 1986). This is somewhat surprising since DDE has been decreasing in most Texas birds. However, DDE concentrations are below levels known to affect reproduction.

Overall, PCB and DDT concentrations were below levels known to affect reproduction. Reproduction of birds nesting on Alexander Island was considered normal. Approximately 1 chick per nest was produced in 1996.

Literature Cited

- Gerston, J. 1995. Galveston Bay characterization. Texas Water Resources, Texas Water Resources Institute, Texas A&M University, College Station, TX., 21(4).
- King, K. A. and A. J. Krynitsky. 1986. Population trends, reproductive success, and organochlorine chemical contaminants in waterbirds nesting in Galveston Bay, Texas. Arch. Environ. Contam. Toxicol. 15:367-376.
- Gardinali, P. R. 1996. Assessment of halogenated aromatic compounds contamination in the Galveston Bay ecosystem. PhD dissertation, Texas A&M University, College Station, TX.
- Sericano, J. L. 1993. The American oyster (*Crassostrea virginica*) as a bioindicator of trace organic contamination. PhD dissertation, Texas A&M University, College Station, TX.
- Yamashita, N. et al. 1993. Embryonic abnormalities and organochlorine contamination in double-crested cormorants (*Phalacrocorax auritus*) and caspian terns (*Hydroprogne caspia*) from the upper Great Lakes in 1988. Environ. Pollut. 79:163-173.
- King, K. A., 1989. Food Habits and organochlorine contaminants in the diet of olivaceous cormorants in Galveston Bay, Texas. Southwest. Nat. 34(3):338-343.